



National Transportation Safety Board Aviation Accident Final Report

Location:	AGUA CALIENTE, AZ	Accident Number:	LAX99FA315
Date & Time:	09/20/1999, 1623 MST	Registration:	N904AW
Aircraft:	Boeing 757-2S7	Aircraft Damage:	None
Defining Event:		Injuries:	2 Serious, 2 Minor, 173 None

Flight Conducted Under: Part 121: Air Carrier - Scheduled

Analysis

During a Ground Proximity Warning System (GPWS) warning escape maneuver at 27,100 feet, 4 flight attendants (FA's) were injured, 2 of them seriously with fractured leg bones. The injured FA's were standing in the aft galley securing from the meal service when the event occurred and the passengers were seated with belts fastened. In response to an ATC instruction, the flight was descending to maintain 27,000 feet; the controller had told the crew to maintain a good rate of descent (the airplane was descending about 4,000 feet per minute), and an indicated airspeed of 300 knots or greater. The flight was in instrument meteorological conditions at the time and had no outside visual reference. The controller advised the flight of opposite direction traffic at 26,000 feet and a traffic alert symbol was being displayed on the crew's TCAS indicator. As the flight was leveling off at 27,000, the opposite direction traffic passed almost directly beneath the flight. Immediately, the GPWS annunciated the warning, "terrain, whoop, whoop, pull-up." In accordance with the mandatory provisions of the company flight operations manual, the crew executed the proscribed escape maneuver, which, in part, calls for an aggressive application of thrust and a rapid nose pitch up to a 20-degree attitude. Later analysis of the DFDR data showed that the crew only rotated the nose to an 8-degree nose up attitude during the maneuver. During the maneuver, the g-loads generated on the airplane varied between +2.5 and +0.5 over a 2-second time period, which was caused the FA's injuries. As part of the investigation, this flight's profile was flown in a Boeing 757 simulator four times. When flown according to operations manual instructions, the g-loads generated ranged from a low of +2.0 to a high of +4.0. It should be noted that the simulator computer computes the g-loads and can display them to the instructor; however, the simulator does not generate visceral feedback to the crew of the amount of g's being experienced. As early as 1988, Boeing became aware that the dash number model GPWS computer installed in the airplane was subject to issuing false warnings when the airplane overflew another airplane. In response, Boeing issued an all operators letter advising of the problem and issued a service letter in 1989 advising of an upgrade to the GPWS computer to prevent false nuisance warnings. Between 1987 and 1999, 3 service bulletins and 13 service letters were issued advising of modifications to the GPWS and Radio Altitude systems to prevent false warnings. None of these improvements were accomplished by the airline, and the GPWS unit installed in

the accident airplane was three upgrades behind the current configuration. The company decision to do Service Bulletin upgrades was based applicability, priority, and budget availability. Service Letters were not routinely reviewed when received, but were filed for later review when discrepancy history patterns indicated a need. For the Boeing 757, the GPWS, TCAS, and Radio Altitude (RA) systems are all interrelated, with the captain's (left side) RA unit providing data input to the GPWS and the TCAS. Review of the maintenance records disclosed that in the 16 months prior to the accident, the GPWS and/or RA systems on this airplane were written up as erratic, providing false warnings, or inoperable 45 times, with 18 discrepancies written up in the 60 days prior to the accident. On three occasions, the GPWS system provided terrain warnings at high altitudes when flying a profile very similar to the accident flight. In accordance with the maintenance manual procedures, the corrective actions largely consisted of removal and replacement of the affected units or sub units. No evidence was found of any diagnostic trouble shooting procedures outside of those specified in the maintenance manuals undertaken by the airline. The airline's maintenance operations control has a system to track problematic airplanes for special maintenance attention, which requires three write-ups in the same ATA code within 10 days to trigger an alert; the accident airplane's discrepancy history pattern fell outside of this "3 in 10" trigger parameter. Flight crews have no ready access to this system and only see on a routine basis the last 10 log sheets where discrepancies are entered. In the 60 days following the accident, extensive examinations of the airplane and/or the GPWS/RA systems was conducted three times in response to continued problems with these systems, with no conclusive hard faults identified. At the end of this 60-day period the RA units were being examined at the system's manufacturer due to a failure that could not be replicated in testing, the manufacturer told the airline that it was aware that the system's central processors could become desynchronized during power transfers and cause erratic behavior in the units. Another cause of earlier (problem corrected before accident flight) erratic behavior in the airplane's RA system was the installation by maintenance of antennas that were incompatible with the computer units; this was due to the airline parts stocking system that carried all dash number models under the same part number.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: the systemic failure of the airline's maintenance department to identify and correct the long standing history of intermittent faults, nuisance warnings, and erratic behavior in this airplane's GPWS system. Also causal is the airline's failure to perform the service bulletins and service letter upgrades to the system, which would have eliminated or greatly reduced the likelihood of this particular nuisance warning, a condition that was identified and corrected by the manufacturers 11 years prior to the accident, and was the subject of one or more of the SB/SL upgrades.

Findings

Occurrence #1: AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION

Phase of Operation: DESCENT - NORMAL

Findings

1. (C) WARNING SYSTEM(OTHER) - FALSE INDICATION
2. (C) MAINTENANCE,SERVICE BULLETIN/LETTER - NOT COMPLIED WITH - COMPANY/OPERATOR MANAGEMENT
3. (C) MAINTENANCE - INADEQUATE - COMPANY MAINTENANCE PERSONNEL

Occurrence #2: MISCELLANEOUS/OTHER

Phase of Operation: MANEUVERING

Findings

4. MANEUVER TO AVOID OBSTRUCTIONS - PERFORMED - FLIGHTCREW

Factual Information

1.1 HISTORY OF FLIGHT

On September 20, 1999, at 1623 mountain standard time, the flight crew of America West Flight 2208, a Boeing 757-2S7, N904AW, executed an escape maneuver when the ground proximity warning system (GPWS) activated near Agua Caliente, Arizona. The aircraft was not damaged; however, 2 flight attendants received serious injuries while 2 others received minor injuries. The remaining flight attendant, the flight crew of 2, and the 170 passengers onboard were not injured. The aircraft was being operated by America West Airlines, Inc., under 14 CFR Part 121 as a scheduled domestic passenger flight when the accident occurred. The flight originated from the Los Angeles International Airport, Los Angeles, California, at 1535 Pacific daylight time that afternoon. Instrument meteorological conditions prevailed at the in-flight altitude of the event and an instrument flight plan was filed.

A review was conducted of the recorded air-ground communications transcripts between the airplane and Albuquerque Air Route Traffic Control Center (ARTCC) and Phoenix Terminal Radar Approach Control. Data plots from the Digital Flight Data Recorder (DFDR) were also compared to the transcript and recorded radar data to reconstruct the events surrounding the GPWS warning and subsequent escape maneuver. In addition, pertinent conversations recorded on the Cockpit Voice Recorder were reviewed.

The flight checked in with ARTCC Sector 91 at 1618 at Flight Level (FL) 300 (30,000 feet msl) with a previous sector's clearance to fly direct to ARLIN intersection. The sector 91 controller acknowledged the flight and assigned a 120-degree heading for traffic separation. Shortly thereafter the controller asked the flight what their indicated airspeed was and the crew replied "265 indicated." The controller turned the flight further right to a 125-degree heading, instructed the flight to descend and maintain FL270, and to increase their indicated airspeed to 300 knots or greater. At 1621, the controller advised the flight to expedite their descent to FL270 and to expect a lower altitude in 2 minutes due to opposite direction traffic below FL270. The controller pointed out the traffic as "11 o'clock 10 miles westbound at flight level 260 [FL260]." The flight responded that they were unable to visually acquire the traffic because they were in instrument meteorological conditions.

At 1623, the controller told the flight to descend and maintain FL240 at a "good rate of descent." The flight responded, "We just got a terrain warning and had to climb out of it." The controller queried, "You mean aircraft warning [because of] that guy below you?" The flight responded, "Negative, must have been a nuisance warning."

According to the crew's written and oral statements, the first officer was the flying pilot. The airplane had been cleared to descend to FL270 and was descending at a rate of about 4,000 feet per minute in instrument meteorological conditions. Albuquerque center issued a traffic advisory for opposite direction traffic at 12 o'clock and passing 1,000 feet below. The traffic was being displayed on the traffic alert and collision avoidance system (TCAS) indicator as an amber traffic alert (T/A) symbol showing "-1700 warning." The TCAS also provided the aural alert, "Traffic, Traffic." As the traffic disappeared from the TCAS indicator, a GWPS "terrain, terrain, whoop, whoop, pull up" warning was received. The first officer said that he looked briefly at the captain who said, "Let's do it." The first officer said he then executed the GPWS escape maneuver as the aural warnings sounded continuously. He increased power to maximum thrust and pitched the nose up to about 8 degrees. The aircraft began a climb at

3,400 fpm. As he reached FL 280, the aural warning ceased and the aircraft entered visual meteorological conditions. As he leveled the aircraft, the captain advised Albuquerque Center that they had received a GPWS warning and had responded. Albuquerque Center asked if was a TCAS alert to which they answered "no." [The four injured flight attendants were standing in the rear galley when the escape maneuver was performed. The events in the cabin are contained in summary form in the SURVIVAL FACTORS section of this narrative; complete statements from all cabin crewmembers can be found in the Survival Factors Group Factual Report, which is appended to this document.]

The crew stated that Albuquerque Center told them to descend and maintain FL 240. As the aircraft began its descent with a vertical speed of about 300 to 500 fpm, the GPWS resumed the same aural warning with an occasional "sink rate." The volume level of the warning made communications in the cockpit difficult, and it was silenced only after the first officer pulled the circuit breaker.

Examination of the radar data and mode C altitude reports from both aircraft obtained from Albuquerque ARTCC disclosed that the true ground track of the flight was 131 degrees in a descent while the opposite direction aircraft's true ground track was 280 degrees while level at FL260. At 1623:27, the opposite direction aircraft was 1.52 nautical miles and on a relative bearing of 350 to America West flight 2208; the radar target returns merged at 1623:34. Based upon calculations of the ground tracks and the timing, the opposite direction aircraft passed laterally behind flight 2208 by about 1,300 feet with a vertical separation of 1,200 feet. The direct distance between the two aircraft at the closest point of approach was about 1,770 feet. The radar data and mode C altitude reports showed that flight 2208's vertical profile changed from a descent to a climb at 1623:38; the change occurred at FL272 and the airplane climbed to FL282 before leveling briefly and then resuming a descent.

Data readout from the DFDR disclosed that the GPWS escape maneuver began at subframe reference 47924 (subframe reference is the number of seconds from beginning of the recording) at an altitude of 27,100 feet. The data traces for the vertical acceleration (g's) oscillated during the escape maneuver from 1 to 2.5 to 0.5 over a 2-second period. Nose-up and down elevator inputs consistent with the vertical acceleration oscillations were recorded during this same 2-second interval. The data plot shows that coincident with engine spool-up, and within about a 2-second interval, the right elevator moved to a 5-degree deflection and the nose pitch attitude achieved 8 degrees. The right elevator then moved to a zero or slightly minus deflection as the nose pitch attitude decreased to 5 degrees. The pitch attitude then increased back to 8 degrees over a 6-second interval, where it remained until the airplane leveled off at 28,250 feet. The plot traces for the Radio Altitude parameter were noted to be erratic from the time of liftoff at Los Angeles until touchdown at Phoenix, with jumps every so often from 1,700 feet to 500. About 5 seconds before the initiation of the escape maneuver, the Radio Altitude jumped from 1,700 to 500, then back to 1,200, then down to 200 before resuming a 1,700 reading. Following that, the Radio Altitude parameter oscillated in 6-second cycles from 1,700 to 200 and back again; this oscillation continued until touchdown at Phoenix.

After the flight resumed a normal descent, it was handed off to ARTCC sector 42, and that controller gave the flight further descent instructions down to FL110 and cleared the flight for the ARLIN 1 arrival procedure into Phoenix. Subsequently, sector 42 handed the flight off to Phoenix Terminal Radar Approach Control (TRACON) at 1628. The flight declared an

emergency at 1637 with Phoenix TRACON, announcing, "We need to get to [runway] 26 right and expedite to gate A14...we have injured flight attendants and a couple are going into shock." The TRACON controller gave the flight priority direct to the runway and the airplane landed at 1641.

The CVR was transcribed and is appended to this report. The recording begins at some point after the aircraft has parked at the gate with the captain noting that the Auxiliary Power Unit (APU) is running and that the "secure checklist" is complete. During the next 5 minutes, the captain and first officer are discussing the event. The first officer remarked, "you know when you're strapped in, and doing that kind of thing in the sim [simulator], you don't realize what kind of an effect [unintelligible word]. I was totally surprised when she said what happened back there." He then went on to note that a status message, "ground prox byte" was on the EICAS in flight after the event.

The crew then had a discussion on the radio with maintenance control informing them of the nature of the event and that the EICAS is now displaying the "ground proximity byte message." Shortly after that, the assistant chief pilot entered the cockpit and the crew discussed the event with him. Comparison of this conversation with the crews later written and oral statements revealed that they are consistent. The conversation then turns toward the need to secure the CVR for readout and how to write up the event on the log page.

A maintenance technician then entered the cockpit and had a discussion first on pulling the CVR, then on the event. After the crew described the GPWS warning and subsequent events, the technician states "This aircraft had a tremendous history on radio altimeter problems...did you have any associated radio altimeter messages or warnings or anything like that?" The first officer responded that they did not.

1.2 PERSONNEL INFORMATION

The America West personnel, flight and training records for both of the flight crew were reviewed. In addition, the FAA Airman and Medical Certification files were examined.

1.2.1 Captain

The captain held an Airline Transport Pilot certificate with a class rating for multiengine land airplanes, with commercial privileges in single engine land airplanes. The most recent issuance of the certificate was dated October 2, 1989. His certificate was endorsed for type ratings in the Boeing 737, 757, and 767. His most recent first-class medical certificate was issued on March 10, 1999, with the limitation that he have available glasses for near vision.

Hired by America West in April 1984, the captain served as a first officer on Boeing 737's and was upgraded to captain in August of that year. He completed transition training and initial operating experience as captain on the Boeing 757 in October 1989. His most recent recurrent proficiency training session was completed in March 1999. A line check was accomplished in August 1999, and the most recent recurrent proficiency check was completed on September 14, 1999.

According to flight department records, the captain had accrued a total flight time of 18,000 hours, with 4,000 as captain on the Boeing 757. In the 90 and 30 days prior to the accident, he flew 186 and 71 hours, respectively.

1.2.2 First Officer

The first officer held an Airline Transport Pilot certificate with a class rating for multiengine land airplanes, with commercial privileges in single engine land airplanes. The most recent issuance of the certificate was dated July 3, 1996. His certificate was endorsed for type ratings in the BA-3100 and BA-4100. His most recent second-class medical certificate was issued on November 11, 1998, without limitations.

Hired by America West in July 1998, the first officer completed his initial training and operating experience for the Boeing 757 in October of that year. His most recent recurrent proficiency training session was completed in April 1999. The most recent recurrent proficiency check was completed on August 24, 1999.

According to flight department records, the first officer had accrued a total flight time of 9,800 hours, with 500 in the Boeing 757. In the 90 and 30 days prior to the accident, he flew 179 and 44 hours, respectively.

1.2.3 GPWS Escape Procedures Training

According to America West's Senior Check Airman for the Boeing 757, GPWS escape procedures are given in both the Proficiency Training and Proficiency Check simulator sessions. The procedure is inserted in the session at random point(s) with no forewarning. The pilot is expected to immediately respond to the warning and fly the procedure specified in the America West Boeing 757-200 Operations Manual. On recognition of the GPWS warning, the pilot is to take the following actions:

- Disengage the autopilot
- Disconnect the autothrottle
- Apply maximum thrust (aggressively)
- Rotate to a 20-degree nose pitch-up attitude (roll wings level if in a bank)
- Retract speedbrakes
- If the terrain threat remains, the nose is to be rotated to either the pitch limit indicator if installed, or stick shaker/stall buffet.

The 757 Operations Manual page covering the procedure has a bold warning notice that states, "Do not delay pull-up for diagnosis." The only exception allowed to the immediate initiation of the escape maneuver is if the flight is in day visual meteorological conditions and positive visual verification can be made that no threat exists.

1.3 AIRCRAFT INFORMATION

1.3.1 Fleet Information, General

At the time of the accident, America West Airlines had its headquarters in Phoenix, Arizona, and operated 104 airplanes, including 1 Boeing 737-100, 17 Boeing 737-200, 44 Boeing 737-300, 13 Boeing 757-200, 21 Airbus A-320-231, and 8 A-320-232 airplanes. The company employed 1,425 pilots and 298 certificated mechanics, and holds Air Carrier Operating Certificate Number AWXA420A.

1.3.2 Boeing 757-200 Series Aircraft

The FAA approved the Model 757-200 (Type Certification Data Sheet A2NM, revision 8, June 1, 1992) for production on December 21, 1982. The airplane is still in production, and 1,001

model 757 airplanes have been built, which includes the 300 series. The airframe maneuvering load factor limits (flaps up) are +2.5 g's positive and -1.0 g's negative.

1.3.3 Accident Airplane Information

The airplane, a Boeing 757-2S7, serial number 23566 (line number 96) was manufactured on May 1, 1986, for Republic Airlines. America West acquired it on June 3, 1987, and at the time of delivery it had accrued 3,377 hours and 1,595 cycles. At the time of the accident, the airframe total time was 55,129 hours and 21,308 cycles. Two Rolls-Royce RB211-535E4 engines were installed, serial number 30515 on the No. 1 position and serial number 30558 on the No. 2 position.

1.3.4 Maintenance Check Intervals

America West Airlines uses a maintenance system that comprises five scheduled maintenance checks. Throughout the following narrative, reference is made to ATA codes. Air Transport Association (ATA) system designations are used in aviation maintenance to create a standardized format. ATA Code sections 31, 33, and 34 refer to instruments, lights, and navigation components, respectively.

RON Check: Accomplished any time the airplane is scheduled for 4 hours or more on the ground where maintenance personnel are assigned and on duty. The last check was completed on September 17, 1999, in Phoenix (log 7357025). There were no ATA 31, 33, or 34 related issues for work activity. No non-routine discrepancies were generated in these areas.

Weekly Check: Accomplished at a maintenance base or approved contract vendor at an interval not to exceed 7 calendar days since the last Weekly Check, "A" Check, or "C" Check. The last check was completed with the "A" Check on September 14, 1999.

"A" Check: Accomplished at intervals not to exceed 30 calendar days in service since the last "A" Check. They are numbered "A1" through "A12" and will be accomplished in numerical sequence from the last check performed. The last check (A10) was completed on September 14, 1999, in Phoenix (log 7357009). There were no ATA 31, 33, or 34 system related issues for work activity. No non-routine discrepancies were generated in these areas.

"C" Check: Accomplished at 18 calendar month intervals since release from the last "C" Check. They are numbered "C1" through "C12" and will be accomplished in numerical sequence. A "C4" check was completed on September 17, 1996, in PHX, and included a work card for the Ground Proximity Warning System (GPWS) test. This test is performed at every other "C" Check. It will thus be accomplished again at the C6 check. No non-routine discrepancies were generated in the related ATA 31, 33, or 34 system areas. The last check (C5) was completed on March 14, 1998, in PHX, and included a TCAS, Radio Altimeter System, and Mode "S" Transponder System test. No non-routine discrepancies were generated in the related ATA 31, 33, or 34 system areas.

1.3.5 Airframe and Component Airworthiness Directive Compliance Status

America West's electronic record of Airworthiness Directives (AD's) on N904AW was reviewed for airframe and component status, including AD's with repetitive intervals. Terminating actions and methods of compliance were also reviewed. No discrepancies were noted.

1.3.6 Airplane Modifications

America West's electronic record of modifications on N904AW was reviewed for all aircraft system ATA sections. The record noted the Engineering Order (EO) of the modification, and whether it was driven by an AD or Service Bulletin (SB). The review revealed the following modifications to the airplane:

EO 34-42-09, (SB 757-34-0050), radio altimeter transceiver upgrade, 09/11/93

EO 34-49-09, windshear detection and warning system, 01/03/90

EO 34-54-02, (AD 92-11-09), mode "S" transponder partial installation, 04/03/92

EO 34-54-03, (SB 757-34-0055), mode "S" transponder installation, 09/16/92

EO 34-54-06, upgrade mode "S" transponder to -201, 12/22/92

EO 34-55-03, (121.201), Traffic Alert/Collision System (TCAS) structural support and cable assemblies, 09/16/92

EO 34-55-36, (AD 94-01-06), TCAS upgrade to 6.04A, 09/25/94

EO 34-55-26, (121.356), TCAS system activation, 02/21/95

EO 34-61-05, (SB 757-34-0154), TCAS full time T/A indicator display, 08/09/99

1.3.7 Service Bulletins Status

A listing of Service Bulletins (SB) issued by Boeing for ATA sections 33 (lights) and 34 (navigation) was reviewed, including those affecting N904AW. According to the records, the following SB's were accomplished by America West:

757-34-0040 (ATA 3400), CMO 34-31-19/EO 34-31-06

757-34-0057 (ATA 3411), EO 34-11-02

757-34-0068 (ATA 3461), EO 34-19-08

757-34-0098 (ATA 3453), EO 34-54-02

757-34-0119 (ATA 3461), EO 34-19-11

The following SB's were applicable to the airplane, but were not accomplished:

757-34-0044 (ATA 3400)

757-34-0053 (ATA 3446)

757-34-0055 (ATA 3421)

757-34-0092 (ATA 3400)

757-34-0102 (ATA 3400)

757-34-0132 (ATA 3412)

In an interview on September 28, 1999, the America West Boeing 757 fleet manager stated that the company policy was not to comply with Service Bulletins.

In a July 15, 2002, letter to Safety Board investigators, the airline's Vice President of Safety stated, "America West has always had a policy of implementing [Service Bulletins]...There is neither a document nor an unwritten policy that suggests that [Service Bulletins] should not be implemented." After pointing out that Service Bulletins and Service Letters are advisory and

not mandatory, he said, "It is and was at the time of this accident the policy of America West for Engineering to evaluate the applicability of Service Bulletins and, where appropriate, to implement them through the issuance of Engineering Orders (EO)." The decision to implement a Service Bulletin or Service Letter involved the issues of applicability, priority and budget availability. He further noted that, "At least eight potentially pertinent (by ATA code) EO's were issued by Engineering to implement SB's on the subject airplane." According to the letter, at the time of the accident, Service Letters were not routinely reviewed for action, but were filed for later review when discrepancy patterns indicated a need.

1.3.8 Boeing Service Letter

A Boeing listing of Ground Proximity Warning Computer (GPWC) part numbers and upgrades was reviewed in comparison to the America West listing of GPWS serialized part numbers, with upgrade status. The following Boeing Service Letters (SL) concerning computer upgrades were also reviewed:

757-SL-34-59	August 26, 1991
757-SL-34-63	February 28, 1992
757-SL-34-65	December 15, 1992
757-SL-34-67	January 22, 1993
757-SL-34-094	July 28, 1995

Three Service Bulletins and 13 Service Letters, issued between 1987 and May 1999, advising improvement modifications in the GPWS and Radio Altimeter Systems were not performed by America West, even though many of the changes increased reliability and reduced what Boeing described as "nuisance alerts." There were three later upgrades available (in the Service Letters not accomplished) for the GPWS computer that could have been installed on airplane N904AW. Review of the Boeing 757 fleet at America West found that component upgrade modifications were not up-to-date with manufacturer's suggested improvements and were several revisions behind the latest version. Even stock interchange units had different installed upgrades applied to them, and the GPWS computers were three upgrades behind the latest modification standard.

1.3.9 Airplane Maintenance Log

In his interview on September 22, 1999, the captain on flight 2208 reported that when they picked up the airplane in Los Angeles for the flight the inbound crew had said the airplane was "fine" and no discrepancies were written up. The captain said he reviewed the logbook and found only 2 prior log sheets instead of the usual 10, and that there were no write-ups on the GPWS or Radio Altimeter system.

The flight duty and airplane maintenance log pages on N904AW were reviewed from August 1, 1999 to September 29, 1999. Included was log page 7357044, which was written on September 20, 1999, following the accident.

All log pages from December 28, 1998 to September 22, 1999, were also reviewed for discrepancies in ATA 31, 33, and 34 areas. All log sheets from N904AW were reviewed from July 1, 1999, to September 29, 1999. A computer-generated report on N904AW for ATA 34 systems was also reviewed from June 15, 1998 to September 20, 1999. Forty-five discrepancies were noted concerning the GPWS system, which includes the radio altimeter system. Eighteen

discrepancies were written up in the 60 days prior to the accident. Detailed review of the log pages revealed several instances of the GPWS providing false terrain warnings and inoperative/erratic radio altimeters. In three prior instances, the GPWS emitted terrain/pull-up warnings at altitudes above FL280 when descent rates were at or about 4,000 feet per minute (similar flight profile to the accident circumstances). In most cases, the discrepancies were resolved by the removal and replacement of various components, and, in the case of the radio altimeter discrepancies, swapping antennas from position to position [it should be noted that these maintenance actions are in full conformity with the applicable maintenance manual procedures]. The log sheet review disclosed that the removal and replacement process in discrepancy resolution solved the immediate need for resolution; however, the same discrepancy would reappear a short time later. Review of the log sheets disclosed no evidence that any diagnostic trouble shooting procedures beyond those specified in the maintenance procedures documents were performed during this period. The log sheets are appended to this report for reference.

The most recent event occurred on September 4, 1999, when the left side Radio Altitude antenna and coax cables were replaced on the airplane due to a history of unresolvable faults that began on August 28. On September 9, the left RA system began to fault again and subsequent investigation by America West maintenance disclosed that the antennas (left versus center and right positions) were mismatched to one another. The antennas were replaced with matching components.

1.3.10 Maintenance Performed on N904AW after Accident Occurrence

September 20, 1999 (log 7357044) at Phoenix: The discrepancy as written stated "Multiple terrain warnings in flight in IMC condition. Terrain avoidance procedures accomplished." The corrective action noted, "Performed T/S IAW 34-46-00 and R/R GPWS computer and Ops. Checked O.K., IAW task card F1B34601." With reference to the Boeing 757 Fault Isolation/Maintenance Manual, Ground Proximity Warning System (GPWS) section 34-46-00 is a trouble-shooting computer procedure. Task Card F1B34601 is a GPWS Operations Check. After these maintenance procedures were completed, the airplane was returned-to-service with no Minimum Equipment List (MEL) items listed.

September 21, 1999 (log 7357049), PHX: The flights recorded were flight 2082 from Phoenix to San Diego and the return leg back to Phoenix as flight 2242. No discrepancies were recorded.

September 21, 1999 (log 7388500) at Phoenix: (new logbook) The entry notes that maintenance robbed a duct clamp to use for another airplane.

September 21, 1999 (log 7388501) at Phoenix: The discrepancy stated, "Perform GPWS A1B34604 task card as requested by maintenance." The noted corrective action was, "Performed card A1B34604 and referenced M/M 34-46-00-5. Task card being revised."

September 21, 1999 (log 7388503) at Phoenix: The discrepancy reported, "Per steps from card A1B34604, MSG's are not displayed on top EICAS display." The corrective action said, "Performed M/M 34-46-00-5. Step 2e states that MSG should be on bottom display. Task card is being revised."

September 21, 1999 (log 7388504) at Phoenix: The entered discrepancy was, "Per step 2a4 of card A1B34064, Ground Proximity Built-in test equipment (BITE) MSG comes up at 17 seconds instead of 12 seconds." The noted corrective action was, "Referenced M/M 34-46-00-

5, correct time limit is 18 sec. See step 2.c. Task card is being revised."

September 21, 1999 (log 7388505) at Phoenix: "RON Check completed."

September 21, 1999 (log 7388506) at Phoenix: "Performed Radio Altimeter Test IAW A1B34609, 9501029, Ops. good."

September 21, 1999 (log 7388507) at Phoenix: The discrepancy was, "Captain's VOR/DME control panel frequency selector will not change frequency in manual." The corrective action noted was, "R/R #1 VOR/DME control panel as required. Tuning and display normal."

Task Card A1B31605 [engine indication an crew alerting system (EICAS) message tracking and digital flight data acquisitions unit (DFDAU) message readout] was also accomplished on N904AW in PHX on September 21, 1999. No messages were recorded on the tracking summary form.

America West Maintenance at Phoenix performed a functional check (A1B34604) on the GPWS after the first series of flights on September 21, 1999. No discrepancies were noted.

September 22, 1999 (log 7388508) at Phoenix: Following a round trip to San Diego, one discrepancy was entered concerning the handset at L-4 jump-seat position. It was ground-checked and found to be normal.

September 22, 1999 (log 7388509) at Phoenix: Replaced a drain from the #2 engine pylon.

September 22, 1999 (log 7388511) at Phoenix: The discrepancy was written up as, "Unusual Turbulence Inspection due." The entered corrective action was, "C/W Turbulence Inspection per MM05-51-04, pages 201-207, part 1-10. No damage noted. Operated all flight controls, no binding noted." The flight vertical load acceleration limits with flaps up are: (+) 2.5g to (-) 1.0g. From the DFDR reading of N904AW, vertical acceleration experienced by the airplane was determined to be (+) 2.48g.

September 22, 1999 (log 7388512) at Phoenix: Robbed #1 engine inboard pylon fairing-panel for another airplane.

September 22, 1999, (log 7388513) at Phoenix: A RON Check was completed.

September 22, 1999 (log 7388514), PHX: The round trip flight from Phoenix to Las Vegas was logged as flight 712 outbound and flight 2682 inbound. One discrepancy was noted concerning the L-2 door slide light.

On September 29, the aircraft was removed from service at the Safety Board's request for a complete diagnostic check of the GPWS and related systems. Technical representatives from all the involved manufacturers participated in the examination. A complete suite of system tests were inconclusive and no hard faults were identified. The Radio Altitude units were removed from the airplane and sent to the manufacturer for further evaluation. A complete report of the Radio Altitude units examination is contained in the Maintenance Records Group Factual report, which is appended to this report.

On October 2, the airplane was ferried to Indianapolis where the next "C" check in order was performed by United Airlines (the contract vendor for America West's heavy maintenance). During this "C" check, the GPWS system failed the task card check and the units were again pulled from the airplane and sent to the manufacturer. No faults were identified in the units. With other GPWS and RA units installed in the airplane, it was returned to service.

An EICAS Ground Proximity status message appeared on November 3, and American West again grounded the airplane for a full range of diagnostic tests. No faults were identified and the airplane was returned to service following an extensive test flight working all modes of the GPWS system.

The airplane was in the process of a RON check at Phoenix on November 10 when a GPWS ground prox status message appeared on the EICAS along with a message announcing failure of the left Radio Altitude unit. Subsequent byte tests confirmed a failure of the left RA unit and it was removed from the airplane and hand-carried to the manufacturer for further examination. Initial testing failed to identify a fault. The unit was then cold-soaked and testing was resumed. Multiple faults were identified when power transfers occurred. In a letter to America West, the manufacturer noted an awareness of problems with the synchronization of the internal CPU's during power transfers and suggested that simply cycling the circuit breaker off and on would result in a re-synchronization of the units.

On November 11, following concurrence by the Radio Altitude manufacturer and Boeing, the airplane was returned to service.

1.3.11 Special Inspection Authorization History

All special inspection authorizations that were logged by AWXA in 1999 were reviewed. This log is maintained by the Engineering Department. No special inspections for B757s in ATA 31, 33, or 34 system areas were noted.

1.3.12 Service Difficulty Reports

No Service Difficulty Reports (SDRs) were generated by America West pertaining to ATA 34 system areas in the Boeing 757 fleet since January 1, 1997. SDR AWXA9900323 was issued on September 21, 1999, as multiple terrain warnings, with MFG Part Number: 965-0648-004, and Serial Number: 855.

1.3.13 America West Technical Support Reports History

The Technical Support Department is part of Maintenance Operations Control, and its function is to follow up on chronic and repetitive discrepancies on specific airplanes. It accomplishes this mission by issuing alerts against components to guide maintenance activity with America West's computer information system. The system is called System Computerized for Economical Performance, Tracking, Recording, and Evaluation (SCEPTRE). The alert level is identified as either "Critical Alert" (air turn backs, emergency landings, inflight diversion, etc.) or "History Alert" (extended delays, items that could cause block turn backs, etc.). The alerts are issued when 3 discrepancies occur within the same ATA code range within 10 days. Review of the discrepancy history of N904AW found that the write-ups fell outside of this "3 in 10" parameter criteria.

The SCEPTRE system normally makes 30-day histories available to maintenance technicians; however, the system can also display a 60-day history on command. These SCEPTRE reports are not made available to the flight crews. The only maintenance history normally available to flight crews is contained in the 10 log pages in the aircraft logbook.

A 60-day report was reviewed for History Alerts and Critical Alerts on N904AW for ATA 34 items. No critical alerts were issued. Fifteen history alerts were issued, including replacement of the R/T unit and both antennas.

1.3.14 Ground Proximity Warning System

The Ground Proximity Warning System (GPWS) provides visual and aural alerts whenever the airplane is in danger of contacting the terrain. When the airplane is below 2,500 feet radio altitude, the GPWS continuously monitors terrain clearance altitude, descent rate, terrain closure rates, glideslope deviation, and flap and gear configuration so that caution and warning alerts can be generated if the airplane is unsafe because of closeness of terrain. AWWA tracked the unit on N904AW as:

MFG P/N: 965-0648-002 (this was originally a Sundstrand P/N that was released in May 3, 1989, and later became Boeing P/N S220T102-203)

M&E P/N: 99-3446-9-0001 S/N: 0277

Tracking Number: 0030435

The unit was installed on May 16, 1999, with a total flight time of 36,049 and 24,607 cycles. At the time of removal on September 20, 1999, after the accident, it had accrued a total time of 37,516 and 25,185 cycles. The unit previously had been installed on airplane 0306 on February 8, 1998, and was removed on March 26, 1999 in LAS, with 24,607 cycles and 36,049:43 total hours, because of a confirmed computer failure. The unit was repaired on March 8, 1999, 578 cycles and 1,466 hours prior to the accident.

In 1988, Boeing became aware of instances where GPWS warnings were triggered by overflying other airplanes and a letter to operators was issued. Subsequently, Service Letter 757-SL-34-38 was issued on November 8, 1989, and advised that an upgrade was available for the S220T102-203 GPWS computer to avoid nuisance GPWS warnings when overflying lower airplanes. The modification changed the computer to an S220T102-204. As noted above, the accident airplane had the -203 computer installed.

1.3.15 Radio Altimeter System

1.3.15.1 General System Information

The Radio Altimeter system consists of a receiver-transmitter (R/T) unit, an indicator, and a transmit and receive antenna. There are three R/T units, each with its own transmit antenna and receive antenna, installed on N904AW. The receiver/transmitter unit computes the altitude, which is then displayed on the electronic attitude director indicator (EADI). The Radio Altimeter data stream is used by the autopilot flight director system, GPWS warning system, TCAS system, and engine indication and crew alerting system (EICAS).

1.3.15.2 History of Units Installed in N904AW

America West's maintenance system tracked the three units by component status as:

Lower Position unit was identified as M&E Part/Serial Number: 19-3450-9-0009 0437 and MFG Part/Serial Number: 622-4542-103 437. It was installed on September 9, 1999. It had accrued a total flight time and number of cycles of 46,205 and 17,898 since new and overhaul, respectively. The time and cycles since installation were 46,056 and 17,833, respectively. The last repair was 65 cycles and 149 hours prior to the accident.

Center Position unit was identified as M&E Part/Serial Number: 19-3450-9-0009 1351 and MFG Part/Serial Number: 622-4542-103 1351. It was installed on October 30, 1998. It had accrued a total flight time and number of cycles of 36,814 and 14,020 since new and overhaul,

respectively. The time and cycles since installation were 33,067 and 12,539, respectively. The last repair was 1,630 cycles and 4,179 hours prior to the accident.

Upper Position unit was identified as M&E Part/Serial Number: 19-3450-9-0009 0450 and MFG Part/Serial Number: 622-4542-103 0450. It was installed on August 28, 1999. It had accrued a total flight time and number of cycles of 45,603 and 17,729 since new and overhaul, respectively. The time and cycles since installation were 45,337 and 17,609, respectively. The last repair was 120 cycles and 265 hours prior to the accident.

At the time of removal from N904AW on September 29, 1999, the unit located on the upper shelf, designated as "left," was serial number 437. The unit located on the middle shelf, designated as "right," was serial number 1351. The unit located on the bottom shelf, designated as "center," was serial number 450.

1.3.15.3 Radio Altimeter Component Compatibility Issues

As noted in section 1.3.9 of this narrative, on September 4, 1999, the left side Radio Altitude antenna and coax cables were replaced on the airplane due to a history of faults that began on August 28. On September 9, the left RA system began to fault again and subsequent investigation by America West maintenance disclosed that the antennas (left versus center and right positions) were mismatched to one another.

In an interview during the investigation, the Manager of Technical Support acknowledged that the mismatched antenna problem was due to the parts stocking system used by America West. The system lists similar parts, which may have different manufacturers part numbers reflecting different modification levels, under the same America West maintenance and engineering part number. He said that unless the individual pulling the part from stock understands the implications of matching sets of avionics systems, an unmatched set could be issued and installed in an airplane.

Concerning the parts stocking system, in a July 15, 2002, letter to Safety Board investigators, the airline's Vice President of Safety said, "This intermix application is supported by an Alternate Parts Approval issued by AWA [America West] in 1994, based on the parts meeting the applicable FAA TSO [Technical Standard Order]."

1.3.16 Traffic Alert and Collision Avoidance System

The Traffic Alert and Collision Avoidance System (TCAS) makes use of existing electrical systems and the capabilities of mode S transponders, which computes altitude. One type of traffic advisory is the resolution advisory (RA), which is displayed on the electronic Traffic Advisory/Vertical Speed Indicator (TA/VI) and provides aural alerts to pilots. The TCAS receiver/transmitter also receives inputs from the ground proximity warning computer (GPWC) and radio altimeter.

America West tracked the unit on N904AW as: M&E Part Number: 99-3450-9-0010, Serial Number 0445 and carried manufacturer's Part Number: 622-8971-120 and serial number 445. The last maintenance/repair performed on the unit was completed March 9, 1999, 867 cycles and 2,222 hours prior to the accident. The unit was installed in the airplane in Phoenix on March 17, 1999, and had accumulated a total time of 22,643 hours and 13,072 cycles.

1.3.17 America West Maintenance System, Reliability Monitoring

America West is authorized through the Operations Specifications D75 to utilize the provisions

of Maintenance Reliability Program (document 0700, dated August 15, 1984), which contains the standards for determining maintenance intervals and processes. Time limitations for overhaul, inspection, and checks of the airplane/systems/components are also controlled by the document.

America West, for the Boeing 757-200, utilizes the Maintenance Review Board (MRB) Report with Maintenance Steering Group (MSG) 3 Maintenance Program Development.

A Reliability Board, consisting of a chairperson and selected members, determines the adequacy of records, and advises sampling thresholds and time limits. They convene at least once a month to review and discuss the past month's performance, as published in a monthly reliability/statistical report.

Twelve months of B757 Reliability Board Meeting Reports were reviewed. The reports include areas such as performance summaries, reliability ATA index reviews, engineering oversight, Service Difficulty Reports, quality control oversight, and maintenance program changes of fleet airplanes. Specific airplanes for discussion are normally not noted, and the minutes and attendance are not listed.

1.4 FLIGHT RECORDERS

1.4.1 DFDR

The airplane was equipped with a solid-state Allied Signal model UFDR, serial number 4050. The unit was removed from the airplane after the event and shipped to the Safety Board's Vehicle Recorders Division. While the entire flight is recorded on the medium, the plot transcription of the data covers a 60-second period that includes the GPWS escape maneuver.

The Vehicle Recorders Division specialist's factual report is appended to this report along with a graphic plot of the data. According to the report, with the exception of the "Radio Altitude" parameter, the data were consistent with normal operations until the escape maneuver initiation approximately 45 minutes into the flight. The radio altitude periodically displayed aberrant and oscillating values throughout the flight from liftoff at Los Angeles through landing at Phoenix. The data traces for the vertical acceleration (g's) oscillated during the escape maneuver from 1 to 2.5 to 0.5 over a 2-second period. Nose-up and down elevator inputs consistent with the vertical acceleration oscillations were recorded during this same 2-second interval. The data plot shows that coincident with engine spool-up, and within about a 2-second interval, the right elevator moved to a 5-degree deflection and the nose pitch attitude achieved 8 degrees. The right elevator then moved to a zero or slightly minus deflection as the nose pitch attitude decreased to 5 degrees. The pitch attitude then increased back to 8 degrees over a 6-second interval, where it remained until the airplane leveled off at 28,250 feet.

1.4.2 Cockpit Voice Recorder

The airplane was equipped with a Fairchild model A-100A CVR, serial number 55359. It was removed from the airplane and shipped to the Safety Board's audio laboratory. The unit contains a 30-minute continuous loop tape, which records over previous material as each 30-minute period elapses. An initial audition of the tape revealed that the 30-minute recording began some time after the flight had arrived at Phoenix. No engine noise or air noise could be heard and the aircraft appeared to be parked at the gate. Nonetheless, the tape contained conversations between the pilots and maintenance personnel and management pilots that were pertinent to the investigation. A CVR group was formed and a transcript of the entire 32

minute 25 second recording was prepared. The transcript is appended to this report.

1.5 METEOROLOGICAL INFORMATION

Review of the available weather data and information supplied in the accident flight crews statements revealed no evidence of any unusual turbulence or meteorological phenomena at the altitude of the GPWS warning and subsequent escape maneuver.

1.6 TESTS AND RESEARCH

1.6.1 GPWS and Related Systems

A technical examination of the GPWS unit was performed on September 29, 1999, at the AlliedSignal Laboratory in Redmond, Washington, to evaluate its status. Members that represented the Maintenance Records Group were from FAA, Boeing, and AlliedSignal. The examination and analysis of data results are contained in the September 30, 1999, report, "MK V Teardown in Redmond, Washington," which is appended to the Maintenance Records Group Factual Report. The MK V GPWS unit passed the resistance value checks and no discrepancies were identified during the teardown inspection.

A technical examination of the radio altimeters was performed at the Rockwell Collins manufacturing facility in Cedar Rapids, Iowa, on October 13-14, 1999, to evaluate the Radio Altimeter equipment installed on the accident airplane. The examination and analysis of data results are contained in the November 3, 1999, report, "Technical Examination of Mishap Components, America West flight 2208; N904AW." During the teardown test of the three Radio Altimeters by Rockwell Collins, R/T (SN 450) failed the production test; however, all three passed the self test cycle. The failed R/T was installed in the number 1 position prior to the accident, and is the only one connected to the GPWS computer.

1.6.2 America West Operating Manual GPWS Escape Maneuver

The GPWS escape procedure is specified in the America West Boeing 757-200 Operations Manual. On recognition of the GPWS warning annunciation, the pilot is to take the following immediate actions:

- Disengage the autopilot

- Disconnect the autothrottle

- Apply maximum thrust (aggressively)

- Rotate to a 20-degree nose pitch-up attitude (roll wings level if in a bank)

- Retract speedbrakes

If the terrain threat remains, the nose is to be rotated to either the pitch limit indicator if installed, or stick shaker/stall buffet.

The 757 Operations Manual page covering the procedure has a bold warning notice that states, "Do not delay pull-up for diagnosis." The only exception allowed to the immediate initiation of the escape maneuver is if the flight is in day visual meteorological conditions and positive visual verification can be made that no threat exists.

1.6.3 Other Airline GPWS Escape Maneuver Procedures

Review of the GPWS escape procedures written into the operations manuals of two major

carriers and in the Boeing Company model 757 flight training manual were found to be largely consistent with the America West procedure and vary only in the details particular to the airplane type.

As part of the investigation, literature on the subject was reviewed. A published alert by the Flight Safety Foundation recommends that when a GPWS warning occurs, "Pilots should immediately and without hesitating to evaluate the warning, execute the pull-up action recommended in the company procedure manual." In the absence of a company procedure, the alert bulletin recommends, "An immediate maximum performance full power climb should be initiated and continued until the GPWS warning stops and the crew determines that terrain clearance is assured."

American Airlines publishes a book, "FLIGHT SAFETY (2002), which is distributed to their pilots. Two articles discuss Controlled Flight Into Terrain (CFIT) and GPWS escape maneuvers.

The first article, "Whoop, Whoop, Pull Up!" noted that an analysis of every CFIT accident to date discloses that "Impact occurred with enough excess [airplane] energy to have cleared the obstruction if the warning and pull-up had been sufficient and timely." The article goes on to point out that, "a successful escape is contingent on a timely (i.e., no delay, 2 to 3 degrees per second) pull-up to a 20-degree wings level pitch attitude to assure the best altitude for airspeed tradeoff."

The second article, "Eight Seconds to Live; GPWS Reaction Times", compares historical escape margin data with crew reaction times in initiating the escape maneuver. The article relates that statistical data "...indicates that, following a 12-second-to-impact warning, an aircraft will miss an average 17-degree mountain slope by just 3.3 seconds if the crew responds in 5 seconds and pitches up at 2 degrees per second to 15 degrees." The article further states that with variations in crew response, "Real world incident data show an average escape margin of only about 1 second."

Both the Flight Safety Foundation alert and the articles contained in the American Airlines publication list recommended actions that closely follow the procedures specified in the America West Boeing 757 Operations Manual.

1.6.4 Simulator Flights Exploring GPWS Escape Maneuver

During the on-scene phase of the investigation, the Operations Group convened at America West's simulator facility, which contains FAA approved Class C simulators for the Boeing 757-200. The initial DFDR readouts were made available to the group. Four separate sessions were flown by Boeing 757-qualified group members replicating the calibrated airspeed and descent rate profile of the accident flight when the escape maneuver was initiated. At an unannounced point in the profile, the GPWS terrain warning was initiated and the flying pilot executed the escape maneuver as written in the America West Boeing 757 Operations Manual. The resultant positive peak g-loads recorded by the simulator instrumentation varied from a low of 2.0 to a high of 4.0. It should be noted that the Class C simulator does not provide any fidelity of visceral feedback to the pilots of g-loads experienced by the airplane.

1.7 SURVIVAL FACTORS/INJURY INFORMATION

A Survival Factors Group was formed and the group's factual report is appended to this document. Five flight attendants were assigned to flight 2208 and the group interviewed all

five. Flight attendants 2 through 5 were injured during the event and medical records pertaining to their treatment were reviewed.

Four of the flight attendants stated that the seat belt sign was on and all the passengers were in their seats when the escape maneuver was performed. The meal service had just concluded and flight attendant No. 1 was in the first class galley. Flight attendants Nos. 2 through 5 were in the aft galley securing from the service.

1.7.1 Flight Attendant No. 1

Flight attendant No. 1 stated that when the event occurred, she felt an unusual motion in the aircraft first, then thinking they were about to encounter turbulence, sat in her jump seat and put the shoulder strap over her shoulder. She described the encounter as feeling "like we dropped," and also felt "light in the stomach." After the event, a passenger rang a call button and informed her that the other flight attendants were in the aft galley and injured. She went to assess the situation, then informed the cockpit via interphone of the four injured flight attendants. The captain asked her to come forward to the cockpit and when she arrived, a computer voice kept repeating "too low, terrain, pull-up." The warning only ceased when she and the first officer were able to find the circuit breaker for the device. She informed the captain of the apparent gravity of the injuries and returned to the cabin. Reaching the aft galley area, she observed that the four injured cabin crewmembers appeared to be going into shock. Two passengers were there assisting the injured and volunteered to remain with them through the landing. She then began preparing the cabin for landing by assuring that all passengers were belted in their seats. At that point she realized that no one was there to cover the doors. She then briefed the passengers seated at doors 2L, 2R, 3L, and 3R of the situation and had them review the emergency procedures. The airplane landed just as she finished.

Flight attendant No. 1 was not injured during the event.

1.7.2 Flight Attendant No. 2

This crewmember was standing at door 4L in the aft galley when she felt something like turbulence with a side to side and up and down motion. She quickly stowed the only cart still unsecured in the galley then felt a "strong upwards force" that she described as hard and continuous "like [she] weighed 3,000 pounds." She said she was "pushed into the floor" and "heard things crunching in [her] feet and legs." She fell to the floor with the other flight attendants and all of them "had problems with [their] legs."

Flight attendant No. 2 wore shoes with 1 1/2 to 2-inch heels. Her injuries consisted of a minimally displaced fracture of the left fibula at the knee joint as well as contusions and sprains/strains of both ankles, the right knee and the lower back.

1.7.3 Flight Attendant No. 3

Flight attendant No. 3 was standing in the rear galley and she and the three others had just finished putting the carts away. She described the event as a "jolt which knocked [her] off [her] feet." She said she also believes that all the flight attendants in the rear galley "knocked into one another."

She said she was wearing "penny loafer" style shoes with an approximate heel height of 1-inch. Her injuries consisted of a non-displaced spiral-type fracture of the distal left fibula as well as abrasions and swelling of the right lateral hip area.

1.7.4 Flight Attendant No. 4

This crewmember said she was standing next to door 4R and had just pushed the last cart into the galley storage space when she was "thrown into the air." She reported hitting the counter, the slide bustle, and the cart before she fell to the floor. She said she could not move her left leg and remained on the floor as two passengers arrived to help them.

She reported wearing black rubber soled loafers with a wedge heel. Her injuries consisted of multiple contusions and strains of the left hip, left knee, left side of the back, right elbow, and neck.

1.7.5 Flight Attendant No. 5

Flight attendant No. 5 was standing in the rear galley facing aft when the event occurred. After feeling what she described as "two little bumps" an "incredible force threw them to the floor." She said she did not strike the ceiling, but hit flight attendant No. 3 and then the floor. According to her statement, the back of her head hit the floor first, followed by her right shoulder and right leg. She said that while lying on the floor she "got quiet, cold and sick," and her right leg was numb.

She said she was wearing a loafer style shoe with 1 to 1 1/2-inch heels. Her injuries consisted of a neck strain and multiple contusions of the right ankle, right knee, and right hip.

1.7.6 America West Cabin Crew Shoe Policy

The airline's Inflight Service Manual (revision date 02AUG99) was reviewed concerning company policy and guidance on cabin crew footwear. Page 02.01.05 discusses shoes for female flight attendants. And states that flat shoes (shoes with no heel) may be worn during the inflight service only and may not be worn during boarding, deplaning, or while walking in terminal areas. A note at the bottom of the page states, "For safety reasons, it is strongly recommended that FA change from heels into flats or low heels after the aircraft doors close and prior to commencement of the safety demonstration."

1.8 ADDITIONAL INFORMATION

Appendix J of 14 CFR Part 121 states that tests for alcohol shall be performed by an employer "As soon as practicable following an accident" if that employee's performance of a safety-sensitive function either contributed to the accident or cannot be completely discounted as a contributing factor to the accident." The pertinent section of the regulation also states, "The decision not to administer a test under this section shall be based on the employer's determination, using the best available information at the time of the determination, that the covered employee's performance could not have contributed to the accident."

The captain and first officer of flight 2208 continued on the next leg of their trip following the assignment of a different airplane. No toxicological tests were performed.

During his interview, the system Assistant Chief Pilot for America West acknowledged that he met the airplane at the gate following receipt of page notifying him of the event. When he arrived at the airplane door, paramedics were still attending to the injured flight attendants. Concerning the status of the captain and first officer, the Assistant Chief Pilot reported that he asked the crew several times if they thought they were capable of continuing on the trip. The crew responded that they were and he released them for duty. When asked if he was aware of

the requirement for drug/alcohol tests of the involved crew in the event of an accident, the Assistant Chief Pilot responded that at the time he "in no way thought this should be classified as an accident." Based on that belief, he did not think a toxicology test was warranted.

Pilot Information

Certificate:	Airline Transport; Commercial	Age:	54, Male
Airplane Rating(s):	Multi-engine Land; Single-engine Land	Seat Occupied:	Left
Other Aircraft Rating(s):	None	Restraint Used:	Seatbelt, Shoulder harness
Instrument Rating(s):	Airplane	Second Pilot Present:	Yes
Instructor Rating(s):	None	Toxicology Performed:	No
Medical Certification:	Class 1 Valid Medical--w/ waivers/lim.	Last FAA Medical Exam:	03/10/1999
Occupational Pilot:	Last Flight Review or Equivalent: 09/14/1999		
Flight Time:	18000 hours (Total, all aircraft), 4000 hours (Total, this make and model), 186 hours (Last 90 days, all aircraft), 71 hours (Last 30 days, all aircraft), 11 hours (Last 24 hours, all aircraft)		

Co-Pilot Information

Certificate:	Airline Transport; Flight Instructor; Commercial	Age:	46, Male
Airplane Rating(s):	Multi-engine Land; Single-engine Land	Seat Occupied:	Right
Other Aircraft Rating(s):	None	Restraint Used:	Seatbelt, Shoulder harness
Instrument Rating(s):	Airplane	Second Pilot Present:	Yes
Instructor Rating(s):	Airplane Multi-engine; Airplane Single-engine; Instrument Airplane	Toxicology Performed:	No
Medical Certification:	Class 1 Valid Medical--no waivers/lim.	Last FAA Medical Exam:	11/16/1998
Occupational Pilot:	Last Flight Review or Equivalent: 08/24/1999		
Flight Time:	9600 hours (Total, all aircraft), 500 hours (Total, this make and model), 179 hours (Last 90 days, all aircraft), 44 hours (Last 30 days, all aircraft), 11 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Boeing	Registration:	N904AW
Model/Series:	757-257 757-257	Aircraft Category:	Airplane
Year of Manufacture:		Amateur Built:	No
Airworthiness Certificate:	Transport	Serial Number:	23566
Landing Gear Type:	Retractable - Tricycle	Seats:	198
Date/Type of Last Inspection:	09/17/1999, Continuous Airworthiness	Certified Max Gross Wt.:	255000 lbs
Time Since Last Inspection:	46 Hours	Engines:	2 Turbo Fan
Airframe Total Time:	55129 Hours at time of accident	Engine Manufacturer:	Rolls-Royce
ELT:	Installed, not activated	Engine Model/Series:	RB-211-535E4
Registered Owner:	The Boeing Company	Rated Power:	40100 lbs
Operator:	AMERICA WEST AIRLINES, INC.	Operating Certificate(s) Held:	Flag carrier (121)
Operator Does Business As:		Operator Designator Code:	AWXA

Meteorological Information and Flight Plan

Conditions at Accident Site:	Instrument Conditions	Condition of Light:	Day
Observation Facility, Elevation:	KPHX, 959 ft msl	Distance from Accident Site:	80 Nautical Miles
Observation Time:	1556 MST	Direction from Accident Site:	60°
Lowest Cloud Condition:	Scattered / 7000 ft agl	Visibility	10 Miles
Lowest Ceiling:	None	Visibility (RVR):	0 ft
Wind Speed/Gusts:	3 knots /	Turbulence Type Forecast/Actual:	/
Wind Direction:	Variable	Turbulence Severity Forecast/Actual:	/
Altimeter Setting:	29.9 inches Hg	Temperature/Dew Point:	34° C / 18° C
Precipitation and Obscuration:			
Departure Point:	LOS ANGELES, CA (LAX)	Type of Flight Plan Filed:	IFR
Destination:	PHOENIX, AZ (PHX)	Type of Clearance:	IFR
Departure Time:	1535 PDT	Type of Airspace:	Class A

Wreckage and Impact Information

Crew Injuries:	2 Serious, 2 Minor, 3 None	Aircraft Damage:	None
Passenger Injuries:	170 None	Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	2 Serious, 2 Minor, 173 None	Latitude, Longitude:	

Administrative Information

Investigator In Charge (IIC):	ROBERT R CRISPIN	Report Date:	07/25/2002
Additional Participating Persons:	RONALD J ROSENHAHN; Federal Aviation Administration, Phoenix CMU; Phoenix, AZ Robert Manning; America West Airlines; Phoenix, AZ Mark Solper; Airline Pilots Association; Phoenix, AZ Phillip Dixon; Association of Flight Attendants; Tempe, AZ		
Publish Date:			
Investigation Docket:	NTSB accident and incident dockets serve as permanent archival information for the NTSB's investigations. Dockets released prior to June 1, 2009 are publicly available from the NTSB's Record Management Division at pubinquiry@ntsb.gov , or at 800-877-6799. Dockets released after this date are available at http://dms.nts.gov/pubdms/ .		

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The Independent Safety Board Act, as codified at 49 U.S.C. Section 1154(b), precludes the admission into evidence or use of any part of an NTSB report related to an incident or accident in a civil action for damages resulting from a matter mentioned in the report. A factual report that may be admissible under 49 U.S.C. § 1154(b) is available [here](#).